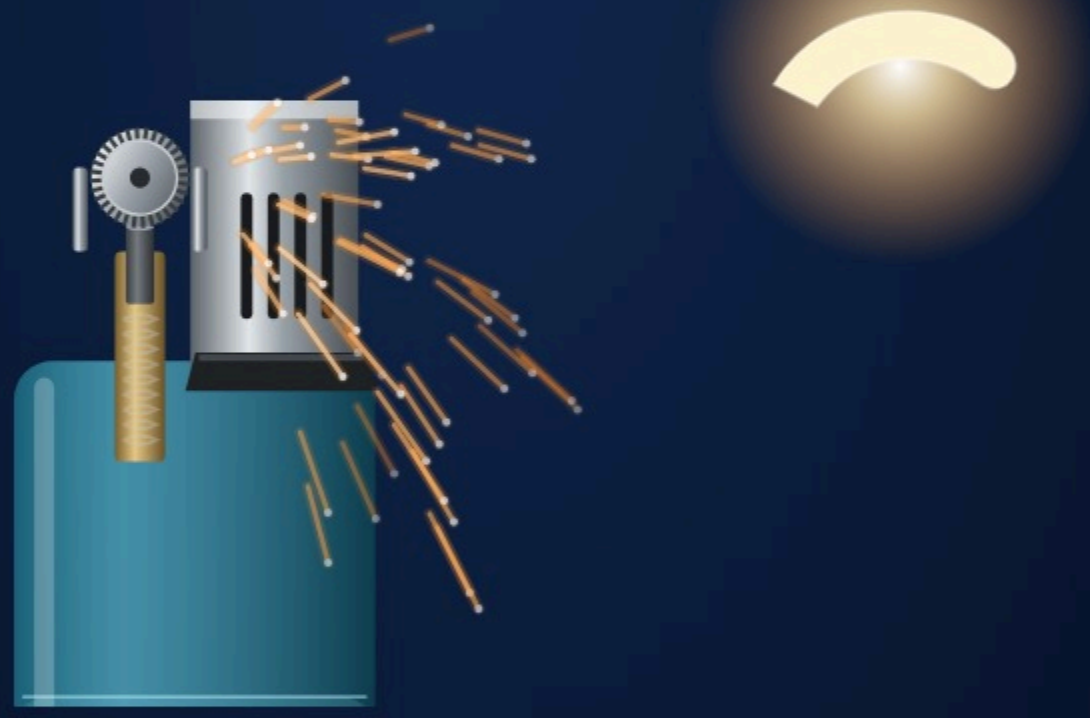
# The spark is burning metal



A lighter "flint" is **not stone**: it is **mischmetall**, ≈ 95% lanthanoids (mostly Ce) + ≈ 5% Fe.

Scraped shavings **catch fire in air**: **the sparks are burning metal**.

# Silvery, soft, reactive



Silvery-white **soft** metals that **tarnish rapidly** in air; good conductors.

Hardness ↑ with Z; **samarium is steel-hard**.

Early Ln react like **Ca**, later ones like **Al**; E° ≈ −2.2 to −2.4 V.

# With $O_2$, halogens, water, acid



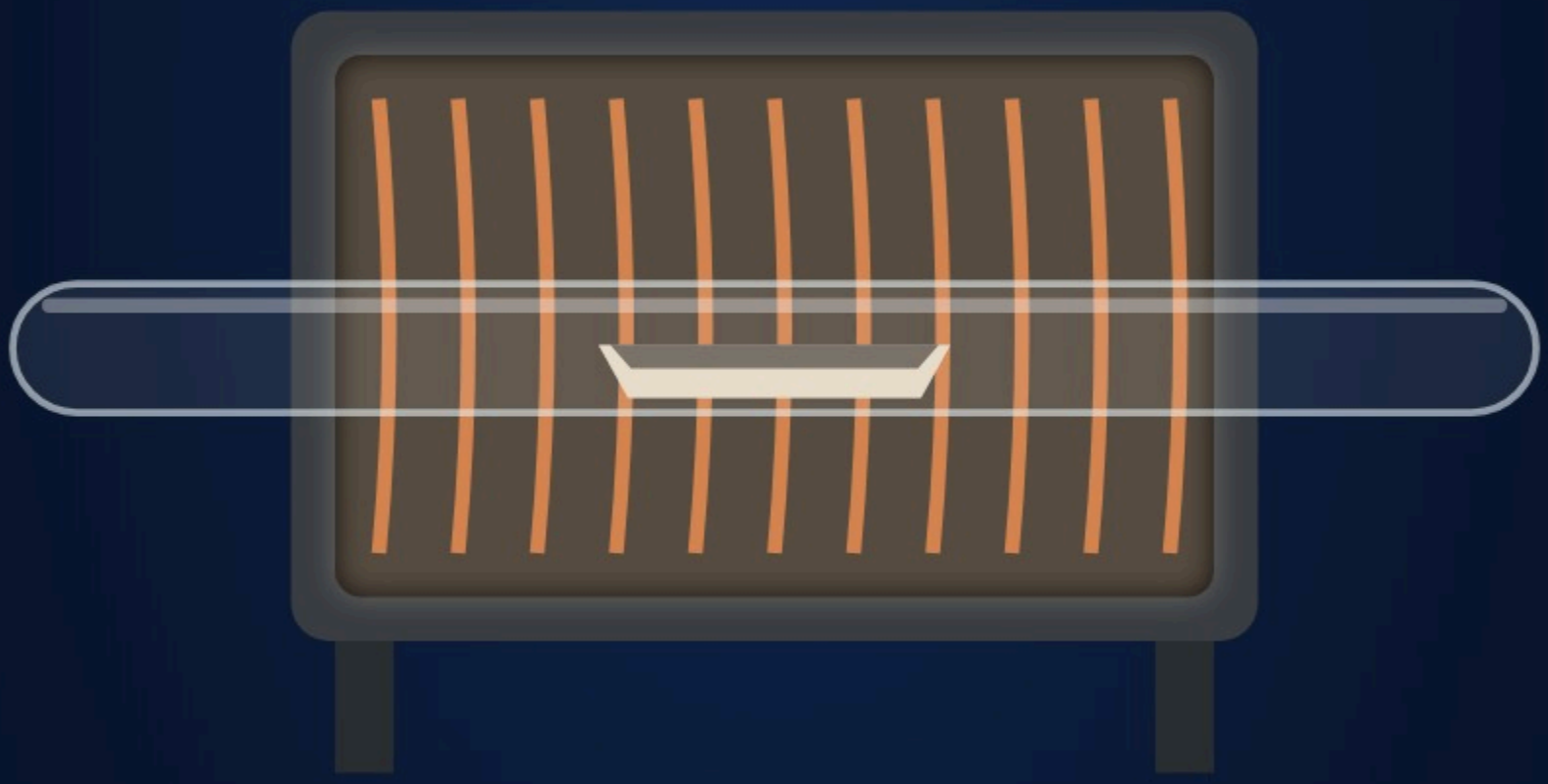

$4Ln + 3O_2 \rightarrow 2Ln_2O_3$ (but Ce $\rightarrow CeO_2$)

$2Ln + 3X_2 \rightarrow 2LnX_3$

$2Ln + 6H_2O \rightarrow 2Ln(OH)_3 + 3H_2$; $2Ln + 6H^+ \rightarrow 2Ln^{3+} + 3H_2$

$Ln_2O_3$ and $Ln(OH)_3$ are **basic**.

# On heating



$2Ln + N_2 \rightarrow 2LnN\ (\Delta)$

$2Ln + 3S \rightarrow Ln_2S_3\ (\Delta)$

$Ln + 2C \rightarrow LnC_2$ (2773 K)

$Ln + H_2 \rightarrow$ hydride (gentle heat)

# Colour from f electrons



$Pr^{3+}$ $Nd^{3+}$ $Er^{3+}$ $La^{3+}$ $Lu^{3+}$

$Pr^{3+}$ green, $Nd^{3+}$ lilac, $Er^{3+}$ pink (pale).

**$La^{3+}$ ($4f^0$) and $Lu^{3+}$ ($4f^{14}$) are colourless.**

# Where they work

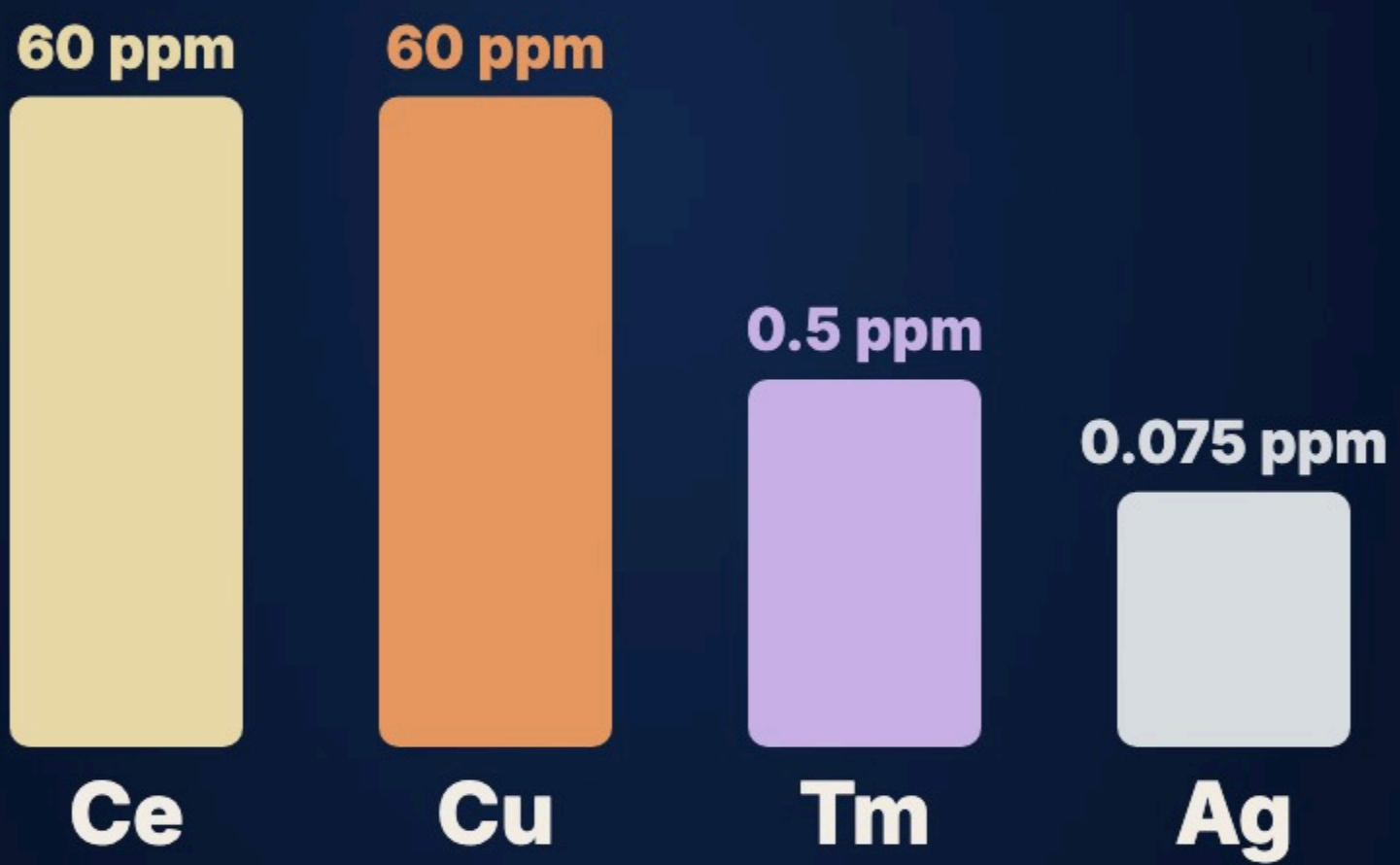



**Alloy steel**: plates and pipes (best single use).

Mischmetall + **Mg** → bullets, shells, lighter flint.

**Cracking catalysts** · **TV phosphors** (Eu red) · **$Nd_2Fe_{14}B$ magnets**

# Rare earths are not rare




Crust (log scale): **Ce ≈ Cu**, ~60 ppm.

Thulium ~0.5 ppm > **silver** ~0.075 ppm.

Hard part: **rich deposits + separation**.

# Your turn

$$CeO_2$$

## Ce = ?

What is the **oxidation state of cerium** in $CeO_2$?

**SAVE** this for revision · **COMMENT** the chapter you want next · **FOLLOW** for more

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